

February 25, 2015

**VIA ELECTRONIC FILING**

Ms. Erica Hamilton, Commission Secretary  
British Columbia Utilities Commission  
Box 250, 900 Howe Street  
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Vancouver, B.C.  
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RE: *North American Electric Reliability Corporation*

Dear Ms. Hamilton:

The North American Electric Reliability Corporation (“NERC”) hereby submits Notice of Filing of the North American Electric Reliability Corporation of Proposed Reliability Standard PRC-010-1 (Undervoltage Load Shedding). NERC requests, to the extent necessary, a waiver of any applicable filing requirements with respect to this filing.

Please contact the undersigned if you have any questions.

Respectfully submitted,

/s/ Holly A. Hawkins

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Enclosure

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**BEFORE THE  
BRITISH COLUMBIA UTILITIES COMMISSION  
OF THE PROVINCE OF BRITISH COLUMBIA**

**NORTH AMERICAN ELECTRIC )  
RELIABILITY CORPORATION )**

**NOTICE OF FILING OF THE  
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION  
OF PROPOSED RELIABILITY STANDARD  
PRC-010-1 (UNDERVOLTAGE LOAD SHEDDING)**

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February 25, 2015

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**BEFORE THE  
BRITISH COLUMBIA UTILITIES COMMISSION  
OF THE PROVINCE OF BRITISH COLUMBIA**

**NORTH AMERICAN ELECTRIC )  
RELIABILITY CORPORATION )**

**NOTICE OF FILING OF THE  
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION  
OF PROPOSED RELIABILITY STANDARD  
PRC-010-1 (UNDERSVOLTAGE LOAD SHEDDING)**

The North American Electric Reliability Corporation (“NERC”) hereby submits proposed Reliability Standard PRC-010-1 (*Undervoltage Load Shedding*) (Exhibit A). The proposed Reliability Standard is just, reasonable, not unduly discriminatory or preferential, and in the public interest.<sup>1</sup> NERC also provides notice of: (i) a revised definition of “Undervoltage Load Shedding Program (UVLS Program)” for inclusion in the NERC Glossary of Terms; (ii) the Implementation Plan for the proposed Reliability Standard (Exhibit B); and (iii) the associated Violation Risk Factors (“VRFs”) and Violation Severity Levels (“VSLs”) (Exhibits A and E). Finally, NERC requests retirement of the following Undervoltage Load Shedding (“UVLS”) Reliability Standards (the “UVLS-Related Standards”), as listed in the Implementation Plan:

- PRC-010-0 – Assessment of the Design and Effectiveness of UVLS Program;
- PRC-020-1 – Under-Voltage Load Shedding Program Database;
- PRC-021-1 – Under-Voltage Load Shedding Program Data; and
- PRC-022-1 – Under-Voltage Load Shedding Program Performance.

Prior to the discussion of proposed Reliability Standard PRC-010-1 below, NERC provides a summary of the recommendations related to UVLS made in the U.S.-Canada Power

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<sup>1</sup> Unless otherwise designated, capitalized terms shall have the meaning set forth in the *Glossary of Terms Used in NERC Reliability Standards* (“NERC Glossary of Terms”), available at [http://www.nerc.com/files/Glossary\\_of\\_Terms.pdf](http://www.nerc.com/files/Glossary_of_Terms.pdf).

System Outage Task Force (“Task Force”) *Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations* (“2003 Blackout Report”)<sup>2</sup> and NERC actions taken in response to those recommendations. NERC also summarizes the Federal Energy Regulatory Commission’s (“FERC”) determinations in Order No. 693<sup>3</sup> for Reliability Standards related to UVLS. As explained below, the proposed PRC-010-1 Reliability Standard reflects consideration of the 2003 Blackout Report recommendations and the FERC determinations in Order No. 693.

This filing, in Section IV, presents the technical basis and purpose of proposed Reliability Standard PRC-010-1, a summary of the development history (Exhibit F), and a demonstration that the proposed Reliability Standard meets the Reliability Standards criteria (Exhibit D). The NERC Board of Trustees (“Board”) adopted proposed Reliability Standard PRC-010-1 on November 13, 2014.

## **I. Executive Summary**

Proposed Reliability Standard PRC-010-1 is a single, comprehensive standard that addresses the same reliability principles outlined in the UVLS-Related Reliability Standards, PRC-010-0, PRC-020-1, PRC-021-1, and PRC-022-1. The purpose of PRC-010-1 is to “establish an integrated and coordinated approach to the design, evaluation, and reliable operation of Undervoltage Load Shedding Programs (UVLS Programs).” Proposed PRC-010-1 represents an improvement to the prior set of UVLS-Related Standards. Proposed PRC-010-1 addresses the FERC directive in Order No. 693, Paragraph 1509 to modify PRC-010-0 to require an integrated and coordinated approach to all protection systems. The proposed Reliability

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<sup>2</sup> U.S.-Canada Power System Outage Task Force, *Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations*, Apr. 2004.

<sup>3</sup> *Mandatory Reliability Standards for the Bulk-Power System*, Order No. 693, 118 FERC ¶ 61,218 (2007).

Standard also replaces the applicability to and involvement of the “Regional Reliability Organization” in Reliability Standards PRC-020-1 and PRC-021-1 and consolidates the UVLS-Related Standards into one comprehensive standard. The proposed Reliability Standard incorporates the proposed definition of “UVLS Program”, which clearly identifies and separates centrally controlled undervoltage-based load shedding, which is now addressed by the proposed definition of “Remedial Action Scheme.”

The proposed Reliability Standard requires applicable entities to evaluate a UVLS Program’s effectiveness prior to implementation, including the UVLS Program’s coordination with other Protection Systems and generator voltage ride through capabilities. Proposed PRC-010-1 also requires UVLS entities to adhere to UVLS Program specifications and the implementation schedule. In addition, applicable entities must perform periodic assessment and performance analysis of UVLS Programs and resolve identified deficiencies. Finally, applicable entities must maintain and share UVLS Program data.

**II. Notices and Communications**

Notices and communications with respect to this filing may be addressed to the following:

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### **III. 2003 Blackout Report**

In the 2003 Blackout Report, the Task Force included Recommendation 21 to “make more effective and wider use of system protection measures.”<sup>4</sup> In addition, the Task Force added three additional recommendations, Recommendation 21A–21C. Recommendations 21B and 21C include actions related to UVLS.

#### **A. Recommendation 21B**

The 2003 Blackout Report identifies that NERC, in support of Recommendation 21, required each regional reliability council to evaluate the feasibility and benefits of UVLS capability in load centers that could become unstable as a result of insufficient reactive power following credible multiple-contingency events. NERC instructed the regional reliability councils to complete the initial studies and report the results to NERC within one year. NERC also provided that the regions should, where beneficial, promote the installation of UVLS

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<sup>4</sup> 2003 Blackout Report at 3, 158.

capabilities in critical areas, as determined by the studies, as an effective way to in prevent or contain an uncontrolled cascade of the power system.<sup>5</sup>

The Task Force recommended, via Recommendation 21B in the 2003 Blackout Report, that NERC require the results of the regional studies to be provided to federal and state or provincial regulators at the same time that they are reported to NERC. In addition, the Task Force recommended that NERC require every entity with a new or existing UVLS program to have a well-documented set of guidelines that specify the conditions and triggers for UVLS use.<sup>6</sup>

Following the issuance of Recommendation 21B, the Board, at its February 2006 meeting, approved a resolution to implement the recommendations contained in the *Review of Regional Evaluations of Undervoltage Load Shedding Capability in Response to NERC Blackout Recommendation 8b* (“Recommendation 8b Report”), which was developed by the NERC Planning Committee.<sup>7</sup> The Board resolution:

- directed the Planning Committee to develop by the end of 2006 a comprehensive set of study guidelines for use in future evaluations of the need and benefit of implementing undervoltage load shedding (UVLS) systems;
- requested each regional reliability council, in conjunction with its members, to develop implementation plans and schedules to install UVLS capability in those load centers where regional studies have identified UVLS as feasible and beneficial to preventing instability and to provide these plans and schedules to the Planning Committee for review by June 2006;
- directed the Planning Committee to review and report to the Board at its August 2006 meeting on the regional UVLS implementation plans and schedules;

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<sup>5</sup> *Id.* at 158 (summarizing NERC actions related to Recommendation 21 on evaluation of the applicability of UVLS). See also NERC, *August 14, 2003 Blackout: NERC Actions to Prevent and Mitigate the Impacts of Future Cascading Blackouts*, Feb. 2004 at 12 (summarizing NERC recommendation 8b, which tracks to Recommendation 21B of the 2003 Blackout Report) (“NERC Blackout Recommendations Report”).

<sup>6</sup> 2003 Blackout Report at 159.

<sup>7</sup> See U.S.-Canada Power System Outage Task Force, *Final Report on Implementation of Task Force Recommendations*, Sept. 2006, at 31-32; see also NERC Board Feb. 7, 2006 Resolution on the Blackout Recommendation 8b Report, available at <http://www.nerc.com/gov/bot/Pages/AgendasHighlightsMinutes.aspx>.

- directed the Planning Committee to survey the existing UVLS systems installed on the Bulk Electric System, to continue to monitor future installations, and support potential future standards activities in this area; and
- directed the Planning Committee to survey the status of research and development efforts on methods to more accurately determine and model load characteristics and to report to the Board at its November 2006 meeting on the results of those efforts.

As noted in the Task Force's *Final Report on Implementation of Recommendations*

("Blackout Implementation Report"), no further action beyond the actions directed by the Board were required to fully implement Recommendation 21B.<sup>8</sup>

### **B. Recommendation 21C**

The 2003 Blackout Report also identified that NERC, in support of Recommendation 21, planned to evaluate Planning Standard III, System Protection and Control, and propose specific revisions to the criteria to address adequately the issue of slowing or limiting the propagation of a cascading failure.<sup>9</sup>

The Task Force further recommended, in Recommendation 21C, that NERC determine the goals and principles needed to establish an integrated approach to relay protection for generators and transmission lines, as well as the use of UFLS and UVLS programs. The Task Force explained that an integrated approach was necessary to ensure that at the local and regional level, these interactive components would provide an appropriate balance of risks and benefits in terms of protecting specific assets and facilitating overall grid survival. The Task Force stated that the review should include an assessment of the appropriate role and scope of UFLS and UVLS, and the appropriate use of time delays in relays. In addition, the task force recommended that in this effort, NERC should work with industry and government research organizations to

<sup>8</sup> See Blackout Implementation Report at 31 (Sept. 2006), available at

[http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/BlackoutFinalImplementationReport\(2\).pdf](http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/BlackoutFinalImplementationReport(2).pdf)

<sup>9</sup> 2003 Blackout Report at 159; see also NERC Blackout Recommendations Report at 13 (summarizing NERC Recommendation 8C, which tracks to Recommendation 21C).

assess the applicability of existing and new technology to make the interconnections less susceptible to cascading outages.

The NERC Planning Committee, at its December 2005 meeting, approved the recommendations of its own blackout recommendations review task force. The NERC Planning Committee's task force also developed an assignment matrix as to which subgroups of the Planning Committee and Operating Committee would address the twenty-four NERC-identified recommendations. The Blackout Implementation Report indicates that completion of the work recommended by the Planning Committee and approval by the Board will constitute full implementation of Recommendation 21C.<sup>10</sup>

#### **IV. Order No. 693 and Description of UVLS-Related Standards**

Following the 2003 Blackout Report, FERC has demonstrated its support of NERC's efforts in addressing Recommendation 21 and the creation of mandatory Reliability Standards for UVLS. While FERC generally viewed the UVLS-Related Standards as improving the reliability of the Bulk-Power System, FERC did identify one area to focus on for the future. In the *Staff Preliminary Assessment of the North American Electric Reliability Council's Proposed Mandatory Reliability Standards* ("Staff Preliminary Assessment"),<sup>11</sup> FERC stated the following regarding UFLS, UVLS, line protection and generation protection:

UFLS and UVLS act as a safety net for the grid. Generation protection systems disconnect the generator to prevent damage to the generator. Line protection systems are designed to sense faults in the lines and, where detected, take the faulty line out of service. An integrated and coordinated approach between UFLS, UVLS, line protection and generation protection is needed to "ensure that at the local and regional level these interactive components provide an appropriate balance of risks and benefits in terms of protecting

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<sup>10</sup> Blackout Implementation Report at 31-32.

<sup>11</sup> See *Staff Preliminary Assessment of the North American Electric Reliability Council's Proposed Mandatory Reliability Standards*, May 11, 2006, Docket No. RM06-16-000.

specific assets and facilitating overall grid survival.”<sup>12</sup>

In Order No. 693, FERC ultimately approved Reliability Standards PRC-010-0, PRC-021-1, and PRC-022-1.<sup>13</sup> However, FERC neither approved nor remanded PRC-020-1 since the Reliability Standard only applied to Regional Reliability Organizations.<sup>14</sup> A summary of each of the UVLS-Related Standard is included below for background.

**A. PRC-010-0**

Reliability Standard PRC-010-0 requires Distribution Providers, Load Serving Entities, Transmission Operators, and Transmission Owners, to periodically assess and document the effectiveness of its program in coordination with its associated Transmission Planner and Planning Authority. The Reliability Standard contains one Requirement<sup>15</sup> and applies to a Load-Serving Entity that operates a UVLS program, a Transmission Owner that owns a UVLS program, a Transmission Operator that operates a UVLS program, and a Distribution Provider that owns or operates a UVLS program.

In its determination approving the PRC-010-0 Reliability Standard, FERC directed NERC to develop a modification to PRC-010-0 through the Reliability Standards development process that “requires that an integrated and coordinated approach be included in all protection systems on the Bulk-Power System, including generators and transmission lines, generators’ low voltage ride-through capabilities, and UFLS and UVLS programs.”<sup>16</sup> The FERC determination also referenced its prior position in the NOPR and stated that “NERC is continuing to develop an

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<sup>12</sup> *Id.* (citing 2003 Blackout Report at 159).

<sup>13</sup> Order No. 693 at PP 1509, 1560, 1565.

<sup>14</sup> *Id.* at 1555.

<sup>15</sup> Requirement R2 and the associated elements were submitted for retirement as part of the Paragraph 81 project on March 19, 2013.

<sup>16</sup> *Id.*

integrated and coordinated approach to protection for generators, transmission lines and UFLS and UVLS programs within its work on the fill-in-the-blank proposed Reliability Standards.”<sup>17</sup>

**B. PRC-020-1**

Reliability Standard PRC-020-1 ensures that a regional database for UVLS programs is available for Bulk-Power System studies by requiring Regional Reliability Organizations with any entities that have UVLS programs to maintain and annually update a database. The Reliability Standard contains two Requirements and applies to any Regional Reliability Organization with entities that own or operate a UVLS program.

**C. PRC-021-1**

Reliability Standard PRC-021-1 requires entities to supply data to support the regional undervoltage load shedding database by requiring the owner of such a system to supply data related to its system and other related protection schemes to its regional reliability organization’s database. The Reliability Standard includes two Requirements and applies to Transmission Owners that own a UVLS program and Distribution Providers that own a UVLS program. In Order No. 693, FERC did not issue directives on the Reliability Standard.

**D. PRC-022-1**

Reliability Standard PRC-022-1 requires entities to ensure that undervoltage load shedding programs perform as intended by requiring each entity that operates such a program to analyze and document all of its operations and misoperations and develop a corrective action plan to avoid future misoperations. The Reliability Standard includes one Requirement and

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<sup>17</sup> Order No. 693 at P 1508 (citing P 883 of the NOPR and the Recommendation 8b Report follow-up work).

applies to Transmission Operators that operate a UVLS program, Distribution Providers that operate a UVLS program, and Load-Serving Entities that operate a UVLS program.<sup>18</sup>

In Order No. 693, FERC did not issue a directive to modify the Reliability Standard. However, FERC did direct NERC to consider comments made by FirstEnergy during the Reliability Standards development process. FirstEnergy summarized that Requirement R1.3 of PRC-022-1 requires “a simulation of the event, if deemed appropriate by the RRO” and believes that the applicable entities such as transmission operators may not be able to simulate large system events.”<sup>19</sup> FirstEnergy suggested that Requirement R1.3 be revised to state that “a simulation of the event, if deemed appropriate, and assisted by the [regional reliability organization].”<sup>20</sup>

## **V. Reliability Standard Development Background**

### **A. NERC Reliability Standards Development Procedure**

The proposed Reliability Standard was developed in an open and fair manner and in accordance with the Reliability Standard development process. NERC develops Reliability Standards in accordance with Section 300 (Reliability Standards Development) of its Rules of Procedure and the NERC Standard Processes Manual.<sup>21</sup> NERC’s proposed rules provide for reasonable notice and opportunity for public comment, due process, openness, and a balance of interests in developing Reliability Standards and thus satisfies certain of the criteria for approving Reliability Standards. The development process is open to any person or entity with a legitimate interest in the reliability of the Bulk-Power System. NERC considers the comments

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<sup>18</sup> Requirement R2 was retired as part of the Paragraph 81 Project previously approved by FERC.

<sup>19</sup> Order No. 693 at P 1564.

<sup>20</sup> *Id.*

<sup>21</sup> The NERC *Rules of Procedure* are available at <http://www.nerc.com/AboutNERC/Pages/Rules-of-Procedure.aspx>. The NERC *Standard Processes Manual* is available at [http://www.nerc.com/comm/SC/Documents/Appendix\\_3A\\_StandardsProcessesManual.pdf](http://www.nerc.com/comm/SC/Documents/Appendix_3A_StandardsProcessesManual.pdf).

of all stakeholders, and stakeholders must approve, and the NERC Board of Trustees must adopt a Reliability Standard before the Reliability Standard is submitted to the applicable governmental authorities.

**B. Project 2008-02 – Undervoltage Load Shedding**

NERC Project 2008-02 was established to modify the UVLS-Related Standards to establish an integrated and coordinated approach to the design, evaluation, and reliable operation of UVLS programs that are used to mitigate undervoltage conditions leading to voltage instability, voltage collapse, or Cascading on the Bulk Electric System. The standard drafting team for Project 2008-02 aimed to consolidate the existing UVLS-Related Standards to create one comprehensive standard and eliminate the Regional Reliability Organization as an applicable entity in Reliability Standard PRC-020-1. The standard drafting team sought to create a results-based standard that clearly defines the responsibilities of applicable entities to:

- pursue an integrated and coordinated approach to the design, evaluation, and reliable operation of automatic, distributed UVLS programs;
- ensure the coordination of automatic, distributed, UVLS programs with generator voltage ride-through capabilities and protection and control systems; and
- establish proper and meaningful automatic, distributed UVLS database requirements.

To accomplish these goals, the standard drafting team considered input from a variety of sources including the 2003 Blackout Report, FERC guidance in Order No. 693, and recommendations from the NERC System Protection and Control Subcommittee (“SPCS”) in its December 2010 *NERC SPCS Technical Review of UVLS-Related Standards: PRC-010-0, PRC-020-1, PRC-021-1, and PRC-022-1* (“SPCS Technical Review”).<sup>22</sup> The SPCS Technical Review is included as

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*See*

[http://www.nerc.com/comm/PC/System%20Protection%20and%20Control%20Subcommittee%20SPCS%20DL/PRC-010\\_022%20Report\\_Approved\\_20101208.pdf](http://www.nerc.com/comm/PC/System%20Protection%20and%20Control%20Subcommittee%20SPCS%20DL/PRC-010_022%20Report_Approved_20101208.pdf).

Exhibit I. The SPCS Technical Review recommended: (1) combining the four existing UVLS Reliability Standards; (2) revising the applicability to entities responsible for UVLS program design, implementation, and coordination; (3) including a requirement for assessment of coordination between UVLS programs and all other protection systems; and (4) differentiating post - event validation of UVLS program design from verifying correct operation of UVLS equipment.

## **VI. Justification**

As discussed in Exhibit D and below, the proposed Reliability Standard PRC-010-1 and the definition of “UVLS Program” are just, reasonable, not unduly discriminatory or preferential, and in the public interest. The following section provides a description of and the technical basis for the proposed definition and Requirements, and describes how the proposed Reliability Standard and associated definition improve reliability and support Recommendation 21 of the 2003 Blackout Report. This section also provides a brief summary of how the proposed Reliability Standards satisfy the outstanding FERC directives from Order No. 693 related to the UVLS-Related Standards. Finally, this section includes a discussion of the enforceability of the proposed Reliability Standard.

### **A. Proposed Reliability Standard PRC-010-1**

Proposed Reliability Standard PRC-010-1 is a single, comprehensive standard that addresses the same reliability principles outlined in the UVLS-Related Reliability Standards, PRC-010-0, PRC-020-1, PRC-021-1, and PRC-022-1. The standard drafting team developed PRC-010-1 using PRC-006-1 (*Automatic Underfrequency Load Shedding*) as a model. Understanding that UVLS and UFLS systems have fundamental differences, the drafting team adopted the industry-vetted reliability principles and language of PRC-006-1 as applicable to

UVLS Programs. The need for and design of UVLS Programs is unique to each system preservation footprint. As a result, the proposed Reliability Standard provides a framework of reliability requirements for such programs to which each individual entity can apply its program's specific considerations and characteristics. Proposed PRC-010-1 does not, however, require a mandatory UVLS Program, nor does this standard address whether an entity needs to employ an UVLS Program. PRC-010-1 applies only after an entity has determined the need for a UVLS Program as a result of its own planning studies.

The purpose of PRC-010-1 is to “establish an integrated and coordinated approach to the design, evaluation, and reliable operation of Undervoltage Load Shedding Programs (UVLS Programs).” Proposed PRC-010-1 represents an improvement to the prior set of UVLS-Related Standards. Proposed PRC-010-1 addresses the FERC directive in Order No. 693, Paragraph 1509 to modify PRC-010-0 to require an integrated and coordinated approach to all protection systems. The proposed Reliability Standard also replaces the applicability to and involvement of the “Regional Reliability Organization” in Reliability Standards PRC-020-1 and PRC-021-1 and consolidates the UVLS-Related Standards into one comprehensive standard. The proposed Reliability Standard incorporates the proposed definition of “UVLS Program”, which clearly identifies and separates centrally controlled undervoltage-based load shedding, which is now addressed by the proposed definition of “Remedial Action Scheme.”

The proposed Reliability Standard applies to Planning Coordinators and Transmission Planners. The applicability includes both the Planning Coordinator and Transmission Planner because either may be responsible for designing and coordinating the UVLS Program. Proposed PRC-010-1 also applies to Distribution Providers and Transmission Owners responsible for the ownership, operation, or control of UVLS equipment as required by the UVLS Program

established by the Transmission Planner or Planning Coordinator. These Distribution Providers and Transmission Owners are referred to as “UVLS entities” within the Applicability section of proposed Reliability Standard PRC-010-1. The phrase “Planning Coordinator or Transmission Planner” within the description of “UVLS entities” in the applicability section provides the latitude for applicability to the entity that will perform the action. The expectation is not that both parties will perform the action, but rather that the Planning Coordinator or Transmission Planner that establishes the UVLS Program will be responsible for identifying the UVLS equipment and the necessary Distribution Providers and Transmission Owners.

1. Proposed Defined Term and Requirements

a) **Proposed Defined Term “UVLS Program”**

A proposed definition of “Undervoltage Load Shedding Program (UVLS Program)” has been introduced and incorporated into the proposed Requirements. This proposed definition sets the parameters for which UVLS systems fall within the scope of the proposed PRC-010-1 Requirements. The proposed defined term reads:

**Undervoltage Load Shedding Program (UVLS Program):** An automatic load shedding program, consisting of distributed relays and controls, used to mitigate undervoltage conditions impacting the Bulk Electric System (BES), leading to voltage instability, voltage collapse, or Cascading. Centrally controlled undervoltage-based load shedding is not included.

The standard drafting team found it necessary to introduce the term “UVLS Program” because different types of UVLS systems need to be treated appropriately with respect to mandatory reliability requirements. The definition for the term UVLS Program includes automatic load shedding programs that utilize only voltage inputs at locations where action is taken to shed load. To ensure that the applicability of the proposed Reliability Standard covers undervoltage-based load shedding systems whose performance has an impact on system

reliability, a UVLS Program must mitigate risk of one or more of the following: voltage instability, voltage collapse, or Cascading impacting the Bulk Electric System. By focusing on the enumerated risks, the definition is meant to inherently exclude locally-applied relays that are designed to protect a contained area or, in other words, are not designed to mitigate wide-area voltage collapse. An example of a program that would not fall under this category is undervoltage-based load shedding installed to mitigate damage to equipment or local loads that are directly affected by the low voltage event.

The definition for the term UVLS Program excludes centrally controlled undervoltage-based load shedding, which utilizes inputs from multiple locations and may also utilize inputs other than voltages (such as generator reactive reserves, facility loadings, equipment statuses, etc.). The design and characteristics of a centrally controlled undervoltage-based load shedding system are the same as that of a Remedial Action Scheme, wherein load shedding is the remedial action. Therefore, just like for a Remedial Action Scheme, the failure of a single component can compromise the reliable operation of centrally controlled undervoltage-based load shedding. This type of UVLS system now falls within the scope of the proposed definition of Remedial Action Scheme, which is also pending.

Of note, the definition of UVLS Program is independent of whether the undervoltage load shedding relays are armed manually or automatically since the arming is done in anticipation of extreme conditions and not during the events when load shedding needs to occur.

## 2. Proposed Requirements

Although the use of UVLS is not mandatory under the proposed Reliability Standard, if it is determined that this system preservation measure is necessary to support reliability and a UVLS Program is installed, the UVLS Program needs to be properly coordinated, implemented,

and assessed due to the inherent associated reliability risks. As such, there needs to be a level of performance required to properly protect system reliability. The Requirements of proposed Reliability Standard PRC-010-1 meet four primary objectives. First, the proposed Reliability Standard requires applicable entities to evaluate a UVLS Program's effectiveness prior to implementation, including the UVLS Program's coordination with other Protection Systems and generator voltage ride through capabilities. Second, applicable entities must adhere to UVLS Program specifications and the implementation schedule. Third, applicable entities must perform periodic assessment and performance analysis of UVLS Programs and resolve identified deficiencies. Finally, applicable entities must maintain and share UVLS Program data.

**a) Requirement R1**

*R1. Each Planning Coordinator or Transmission Planner that is developing a UVLS Program shall evaluate its effectiveness and subsequently provide the UVLS Program's specifications and implementation schedule to the UVLS entities responsible for implementing the UVLS Program. The evaluation shall include, but is not limited to, studies and analyses that show: [Violation Risk Factor: High] [Time Horizon: Long-term Planning]*

*1.1. The implementation of the UVLS Program resolves the identified undervoltage issues that led to its development and design.*

*1.2. The UVLS Program is integrated through coordination with generator voltage ride-through capabilities and other protection and control systems, including, but not limited to, transmission line protection, autoreclosing, Remedial Action Schemes, and other undervoltage-based load shedding programs.*

Proposed Requirement R1 requires each Planning Coordinator or Transmission Planner that develops a UVLS Program to evaluate the viability and effectiveness of the UVLS Program

before implementation. This evaluation must include, but is not limited to whether implementation of the program resolves the identified undervoltage conditions that led to its design, and whether the UVLS Program is integrated through coordination with generator voltage ride-through capabilities and other protection and control systems. Though presented as separate subparts in the proposed Requirement, the studies that show coordination considerations and that the program addresses undervoltage issues may be interrelated and presented as one comprehensive analysis.

Proposed Requirement R1 also requires the Planning Coordinator or Transmission Planner to provide the UVLS Program's specifications and implementation schedule to applicable UVLS entities to implement the program. It is noted that studies to evaluate the effectiveness of the program must be completed prior to providing the specifications and schedule under the proposed Requirement.

**b) Requirement R2**

*R2. Each UVLS entity shall adhere to the UVLS Program specifications and implementation schedule determined by its Planning Coordinator or Transmission Planner associated with UVLS Program development per Requirement R1 or with any Corrective Action Plans per Requirement R5. [Violation Risk Factor: High] [Time Horizon: Long-term Planning]*

Proposed Requirement R2 requires UVLS entities, as defined in the Applicability section of PRC-010-1, to meet the specifications and implementation schedule provided by the Planning Coordinator or Transmission Planner for a UVLS Program (designed under R1) or address any necessary corrective actions for a UVLS Program (developed under R2). If UVLS entities do not implement the UVLS Program according to the specifications and schedule provided, the UVLS Program may not be effective and may not achieve its intended goal.

**c) Requirement R3**

*R3. Each Planning Coordinator or Transmission Planner shall perform a comprehensive assessment to evaluate the effectiveness of each of its UVLS Programs at least once every 60 calendar months. Each assessment shall include, but is not limited to, studies and analyses that evaluate whether: [Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*

*3.1. The UVLS Program resolves the identified undervoltage issues for which the UVLS Program is designed.*

*3.2. The UVLS Program is integrated through coordination with generator voltage ride-through capabilities and other protection and control systems, including, but not limited to, transmission line protection, autoreclosing, Remedial Action Schemes, and other undervoltage-based load shedding programs.*

In addition to the initial studies required to develop a UVLS Program, periodic comprehensive assessments are required for continued effectiveness of the UVLS Program. Proposed Requirement R3 requires this type of assessment to be completed at least once every sixty (60) calendar months to capture the cumulative effects of minor changes to the system that have occurred since the last assessment was completed. This comprehensive assessment supplements the annual assessment to evaluate the impact of Protection Systems required under Reliability Standard TPL-001-4. The 60-month period is the same time frame used for assessments in TPL-001-4 and also in the PRC-006-1 assessment related to underfrequency load shedding. The UVLS Program assessment must include studies and analysis that evaluate the program based on two criteria, as described in subparts R3.1 and R3.2. These metrics are the same two criteria used in the assessment under Requirement R1.

While not included in Requirement R3, at any point in time, a Planning Coordinator or Transmission Planner may determine that a material change to system topology or operating

conditions affects the performance of the UVLS Program and, therefore, necessitates the same comprehensive assessment. If a Planning Coordinator or Transmission Planner conducts a comprehensive assessment sooner for the reasons discussed above, the 60-month time period would restart upon completion of this assessment.

**d) Requirement R4**

*R4. Each Planning Coordinator or Transmission Planner shall, within 12 calendar months of an event that resulted in a voltage excursion for which its UVLS Program was designed to operate, perform an assessment to evaluate whether its UVLS Program resolved the undervoltage issues associated with the event. [Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*

When a UVLS Program does not function as expected and designed during a voltage excursion event, this presents a risk to system reliability. To mitigate this risk, proposed Requirement R4 requires applicable entities to commence a timely assessment to evaluate whether the UVLS Program resolved the undervoltage issues associated with the applicable event. This assessment must be completed within twelve calendar months from the date of the event, as this timeframe provides the requisite time to coordinate with other Planning Coordinators, Transmission Operators, Transmission Planners and UVLS entities to complete the performance assessment.

**e) Requirement R5**

*R5. Each Planning Coordinator or Transmission Planner that identifies deficiencies in its UVLS Program during an assessment performed in either Requirement R3 or R4 shall develop a Corrective Action Plan to address the deficiencies and subsequently provide the Corrective Action Plan, including an implementation schedule, to UVLS entities within three calendar months of completing the assessment. [Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*

If program deficiencies are identified during an assessment of a UVLS Program performed in either Requirement R3 or R4, the Planning Coordinator or Transmission Planner must develop a Corrective Action Plan to address the deficiencies.

The proposed Requirement sets a time period of three calendar months to provide the Corrective Action Plan to UVLS entities. Based on the drafting team's knowledge and experience with UVLS studies, three calendar months was determined to provide a judicious balance between the reliability need to address deficiencies expeditiously and the time needed to consider potential solutions, coordinate resources, develop a Corrective Action Plan and implementation schedule, and provide the Corrective Action Plan and schedule to UVLS entities. The three-month time frame is only to develop the Corrective Action Plan and provide it to UVLS entities and does not encompass the time UVLS entities have to implement the Corrective Action Plan. Proposed Requirement R2 requires UVLS entities to execute the Corrective Action Plan according to the schedule provided by the Planning Coordinator or Transmission Planner.

**f) Requirement R6, R7, and R8**

*R6. Each Planning Coordinator that has a UVLS Program in its area shall update a database containing data necessary to model the UVLS Program(s) in its area for use in event analyses and assessments of the UVLS Program at least once each calendar year. [Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

*R7. Each UVLS entity shall provide data to its Planning Coordinator according to the format and schedule specified by the Planning Coordinator to support maintenance of a UVLS Program database. [Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

*R8. Each Planning Coordinator that has a UVLS Program in its area shall provide its UVLS Program database to other Planning Coordinators and Transmission Planners within its Interconnection, and other functional entities with a reliability*

*need, within 30 calendar days of a written request. [Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

Having accurate and current data is required for the Planning Coordinator to perform undervoltage studies and for use in event analyses. Proposed Requirement R6 supports this reliability need by requiring the Planning Coordinator to update its UVLS Program database at least once each calendar year. Proposed Requirement R7 requires the UVLS entity to provide UVLS Program data in accordance with specified parameters. Proposed Requirement R8 requires that UVLS Program data be shared with neighboring Planning Coordinators and Transmission Planners within a reasonable time period. Requests for the database must also be fulfilled for those functional entities that have a reliability need for the data.

A UVLS Program database may include, but is not limited to, the following:

- Owner and operator of the UVLS Program
- Size and location of customer load, or percent of connected load, to be interrupted
- Corresponding voltage set points and clearing times
- Time delay from initiation to trip signal
- Breaker operating times
- Any other schemes that are part of or impact the UVLS Programs, such as related generation protection, islanding schemes, automatic load restoration schemes, UFLS, and Remedial Action Schemes.

#### **B. Misoperation of UVLS Equipment**

During the development of PRC-004-3 (Project 2010-05.1) and PRC-010-1 (Project 2008-02), both standard drafting teams decided that the UVLS standard drafting team would address the Misoperation of UVLS equipment stemming from the retirement of PRC-022-1 (*Under-Voltage Load Shedding Program Performance*). The PRC-022-1 Reliability Standard

addressed Misoperation of UVLS; however, it was retired with the creation of PRC-010-1, which was adopted by the Board on November 13, 2014. This aspect of PRC-022-1 will be accounted for through further development work in Project 2008-02.2 Phase 2 Undervoltage Load Shedding (UVLS): Misoperations.<sup>23</sup> This phase of the UVLS project will address Misoperation of UVLS equipment to complete the work anticipated by the two standard drafting teams. The standard drafting team is currently working to make the necessary standard changes and anticipates submitting proposed changes to Board in May for adoption pending favorable ballot results.

### **C. Enforceability of Proposed Reliability Standard**

The proposed Reliability Standard PRC-010-1 includes Measures that support each Requirement to help ensure that the Requirements will be enforced in a clear, consistent, non-preferential manner and without prejudice to any party. The proposed Reliability Standard also includes VRFs and VSLs for each Requirement. The VRFs and VSLs for the proposed Reliability Standard comport with NERC and FERC guidelines related to their assignment. A detailed analysis of the assignment of VRFs and the VSLs for proposed PRC-010-1 is included as Exhibit E.

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<sup>23</sup> The Project webpage is available at [http://www.nerc.com/pa/Stand/Pages/Project-2008-02\\_2-Phase-2-Undervoltage-Load-Shedding-UVLS-Misoperations.aspx](http://www.nerc.com/pa/Stand/Pages/Project-2008-02_2-Phase-2-Undervoltage-Load-Shedding-UVLS-Misoperations.aspx).

Respectfully submitted,

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Date: February 25, 2015

**EXHIBITS A—C and E – I**

(Available on the NERC Website at

[http://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/Attachments\\_PRC-010-1\\_UVLS.pdf](http://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/Attachments_PRC-010-1_UVLS.pdf))

## EXHIBIT D

### **Reliability Standards** **Criteria**

The discussion below explains how the proposed definition for “Remedial Action Scheme” (Exhibit A) and the Proposed Reliability Standards (Exhibit B) have met or exceeded the Reliability Standards criteria.

**1. Proposed Reliability Standards must be designed to achieve a specified reliability goal and must contain a technically sound means to achieve that goal.**

Proposed Reliability Standard PRC-010-1 is a single, comprehensive standard that addresses the same reliability principles outlined in the UVLS-Related Reliability Standards, PRC-010-0, PRC-020-1, PRC-021-1, and PRC-022-1. The purpose of PRC-010-1 is to “establish an integrated and coordinated approach to the design, evaluation, and reliable operation of Undervoltage Load Shedding Programs (UVLS Programs).” The standard drafting team developed PRC-010-1 using PRC-006-1 (Automatic Underfrequency Load Shedding) as a model. With the understanding that UVLS and UFLS systems have fundamental differences, the drafting team adopted the industry-vetted reliability principles and language of PRC-006-1 as applicable to UVLS Programs as a guide for development of proposed PRC-010-1. The need for and design of UVLS Programs is unique to each system preservation footprint. As a result, the proposed Reliability Standard provides a framework of reliability requirements for such programs to which each individual entity can apply its program’s specific considerations and characteristics. Proposed PRC-010-1 does not, however, require a mandatory UVLS Program, nor does this standard address whether an entity needs to employ an UVLS Program. PRC-010-1 applies only after an entity has

determined the need for a UVLS Program as a result of its own planning studies.

The proposed Reliability Standard is a technically sound means of meeting the purpose statement of the proposed Reliability Standard. The proposed Reliability Standard employs measures prior to implementation of a UVLS Program, during, and following deployment of a UVLS Program. The proposed Reliability Standard requires applicable entities to evaluate a UVLS Program's effectiveness prior to implementation, including the UVLS Program's coordination with other Protection Systems and generator voltage ride through capabilities. Proposed PRC-010-1 also requires UVLS entities to adhere to UVLS Program specifications and the implementation schedule. In addition, applicable entities must perform periodic assessment and performance analysis of UVLS Programs and resolve identified deficiencies. Finally, applicable entities must maintain and share UVLS Program data.

**2. Proposed Reliability Standards must be applicable only to users, owners and operators of the bulk power system, and must be clear and unambiguous as to what is required and who is required to comply.**

The proposed Reliability Standard applies to Planning Coordinators and Transmission Planners. The applicability includes both the Planning Coordinator and Transmission Planner because either may be responsible for designing and coordinating the UVLS Program. Proposed PRC-010-1 also applies to Distribution Providers and Transmission Owners responsible for the ownership, operation, or control of UVLS equipment as required by the UVLS Program established by the Transmission Planner or Planning Coordinator. These Distribution Providers and Transmission Owners are referred to as "UVLS entities" within the Applicability section of proposed Reliability Standard PRC-010-1. The phrase "Planning Coordinator or Transmission Planner" within the description of "UVLS entities" in the

applicability section provides the latitude for applicability to the entity that will perform the action. The expectation is not that both parties will perform the action, but rather that the Planning Coordinator or Transmission Planner that establishes the UVLS Program will be responsible for identifying the UVLS equipment and the necessary Distribution Providers and Transmission Owners.

The proposed Requirements contain clear language and identification of the responsible entities. In addition, a proposed definition of “Undervoltage Load Shedding Program (UVLS Program)” has been introduced and incorporated into the proposed Requirements. This proposed definition sets the parameters for which UVLS systems fall within the scope of the proposed PRC-010-1 Requirements and provides further clarity on what is covered by the proposed Reliability Standard.

**3. A proposed Reliability Standard must include clear and understandable consequences and a range of penalties (monetary and/or non-monetary) for a violation.**

The Violation Risk Factors (“VRFs”) and Violation Severity Levels (“VSLs”) for the proposed Reliability Standard comport with NERC and FERC guidelines related to their assignment. The assignments of the severity levels for the VSLs are consistent with the corresponding Requirement and will ensure uniformity and consistency in the determination of penalties. The VSLs do not use any ambiguous terminology, and support uniformity and consistency in the determination of similar penalties for similar violations. For these reasons, the proposed Reliability Standard includes clear and understandable consequences. Justification and explanation of the VRFs and VSLs is included in Exhibit E.

**4. A proposed Reliability Standard must identify clear and objective criterion or measure for compliance, so that it can be enforced in a consistent and non- preferential manner.**

The proposed Reliability Standard contains Measures that support the Requirements by clearly identifying what is required and how the Requirements will be measured for compliance. The Measures are listed after each of the Requirements of the proposed PRC-010-1 Reliability Standard and provide clarity on types of evidence to support each Requirement, which will allow the Requirements to be enforced in a consistent and non-preferential manner. The Measures are provided within the proposed Reliability Standard in Exhibit A.

**5. Proposed Reliability Standards should achieve a reliability goal effectively and efficiently — but do not necessarily have to reflect “best practices” without regard to implementation cost or historical regional infrastructure design.**

The proposed Reliability Standard achieves the reliability goal effectively and efficiently. The need for and design of UVLS Programs is unique to each system preservation footprint. As a result, the proposed Reliability Standard provides a framework of reliability requirements for such programs to which each individual entity can apply its program’s specific considerations and characteristics. Proposed PRC-010-1 does not, however, require a mandatory UVLS Program, nor does this standard address whether an entity needs to employ an UVLS Program. PRC-010-1 applies only after an entity has determined the need for a UVLS Program as a result of its own planning studies. The purpose of PRC-010-1 is to “establish an integrated and coordinated approach to the design, evaluation, and reliable operation of Undervoltage Load Shedding Programs (UVLS Programs).” The proposed Reliability Standard provides the necessary Requirements to achieve the purpose statement, while maintaining the flexibility and discretion to design and

employ a UVLS Program based on the needs of a system.

- 6. Proposed Reliability Standards cannot be “lowest common denominator,” *i.e.*, cannot reflect a compromise that does not adequately protect Bulk-Power System reliability. Proposed Reliability Standards can consider costs to implement for smaller entities, but not at consequences of less than excellence in operating system reliability.**

The proposed definition and revisions to the Proposed Reliability Standards do not reflect a “lowest common denominator” approach. Proposed PRC-010-1 represents an improvement to the prior set of UVLS-Related Standards. Proposed PRC-010-1 addresses the FERC directive in Order No. 693, Paragraph 1509 to modify PRC-010-0 to require an integrated and coordinated approach to all protection systems. The proposed Reliability Standard also replaces the applicability to and involvement of the “Regional Reliability Organization” in Reliability Standards PRC-020-1 and PRC-021-1 and consolidates the UVLS-Related Standards into one comprehensive standard. The proposed Reliability Standard incorporates the proposed definition of “UVLS Program”, which clearly identifies and separates centrally controlled undervoltage-based load shedding, which is now addressed by the proposed definition of “Remedial Action Scheme.”

- 7. Proposed Reliability Standards must be designed to apply throughout North America to the maximum extent achievable with a single Reliability Standard while not favoring one geographic area or regional model. It should take into account regional variations in the organization and corporate structures of transmission owners and operators, variations in generation fuel type and ownership patterns, and regional variations in market design if these affect the proposed Reliability Standard.**

The proposed Reliability Standard applies throughout North America and does not favor one geographic area or regional model.

**8. Proposed Reliability Standards should cause no undue negative effect on competition or restriction of the grid beyond any restriction necessary for reliability.**

The proposed PRC-010-1 will not cause undue negative effect on competition or result in any unnecessary restrictions. Proposed PRC-010-1 focuses solely on the establishing an integrated and coordinated approach to the design, evaluation, and reliable operation of UVLS Programs.

**9. The implementation time for the proposed Reliability Standard is reasonable.**

The suggested effective dates for the proposed definition and Reliability Standards are just and reasonable. NERC proposes an effective date of the first day of the first calendar quarter that is twelve (12) months after approval by an applicable governmental authority or as otherwise provided for in a jurisdiction where approval by an applicable governmental authority is required for a standard to go into effect. Where approval by an applicable governmental authority is not required, the standard and the definition shall become effective on the first day of the first calendar quarter that is twelve (12) months after the date the standard and definition are adopted by the NERC Board of Trustees or as otherwise provided for in that jurisdiction. This period will allow time for entities to review current systems and make any necessary adjustments in their internal processes necessary to implement the proposed the new definition and related Reliability Standards based on the increased granularity of the proposed definition. The proposed implementation plan is attached as Exhibit B.

**10. The Reliability Standard was developed in an open and fair manner and in accordance with the Reliability Standard development process.**

The proposed definition and Reliability Standards were developed in accordance with

NERC's ANSI- accredited processes for developing and approving Reliability Standards.<sup>24</sup>

Exhibit F includes a summary of the development proceedings and details the processes followed to develop the proposed definition and Reliability Standards. These processes included, among other things, comment and balloting periods. Additionally, all meetings of the drafting team were properly noticed and open to the public.

**11. NERC must explain any balancing of vital public interests in the development of proposed Reliability Standards.**

NERC has identified no competing public interests regarding the request for approval of the proposed PRC-010-1 Reliability Standard. No comments were received that indicated the proposed Reliability Standard conflicts with other vital public interests.

**12. Proposed Reliability Standards must consider any other appropriate factors.**

No other factors relevant to whether the proposed Reliability Standard is just and reasonable were identified.

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<sup>24</sup> See NERC *Rules of Procedure*, Section 300 (Reliability Standards Development) and Appendix 3A (Standard Processes Manual).